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Market Potential for

PROCESSED POTATO PRODUCTS

UNITED STATES DEPARTMENT OF AGRICULTURE
Economic Research Service
Marketing Economics Division

Marketing Research Report No. 505

PREFACE

This report deals with market expansion possibilities for dehydrated mashed potatoes and frozen french fried potatoes. The research was conducted in collaboration with the regional utilization research laboratories of the Department.

An earlier study evaluated the market potential for potato flakes developed by the Eastern Utilization Research and Development Division, Agricultural Research Service. (Potato Flakes--A New Form of Dehydrated Potatoes: Market Position and Consumer Acceptance in Binghamton, Endicott, and Johnson City, N. Y., U. S. Dept. Agr., Mktg. Res. Rpt. 186.) Several agencies in Maine participated in the market test for potato flakes during the summer of 1956. The favorable results sparked interest in potato flakes and led to the commercial manufacture of the product beginning in 1957. The estimated 1961 market value of flakes is slightly over $30 million or one-third of the total value of dehydrated mashed potatoes.

The present study was conducted under the general supervision of Marshall E. Miller and Philip B. Dwoskin of the Economic Research Service. Morris W. Sills, Robert V. Enochian, and Frank D. Barlow assisted in planning and conducting the study. James Cording, Jr., Agricultural Research Service, provided technical assistance.

Appreciation is extended to the Philadelphia Restaurant Association, institutional buyers and suppliers of processed potatoes, and store managers who made data available.

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October 1961

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MARKET POTENTIAL FOR PROCESSED POTATO PRODUCTS X

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HIGHLIGHTS

Extraordinary growth has occurred in the demand for dehydrated mashed and frozen french fried potatoes. The utilization of potatoes for processing into frozen french fries and dehydrated mashed potatoes nearly doubled from 1958 to 1960. Nearly a fourth of the potatoes used for food, excluding starch and flour, are now processed. Half of the potatoes used for processing in 1960 were processed into dehydrated and frozen potato products. 1/

The development of new potato products since 1956 has benefited farmers, consumers, processors, and others. Consumers have been offered a number of new convenient-to-use, easy-to-store, high-quality potato products at reasonable prices. Acceptance of these products by consumers, both household and institutional, is evidenced by the fact that the long-term decline in potato consumption per person has leveled off, with a favorable effect on farmer's income. In addition, the introduction of new products has expanded the potato processing industry.

The retail market offers the largest potential for expanding sales of dehydrated mashed potatoes and frozen french fries. Four-fifths of the total food supply moves through retail channels, but thus far only three-fifths of the dehydrated mashed potatoes and two-fifths of the frozen french fries are sold through retail stores.

Mashed potatoes represent an estimated 34 percent of home consumption of fresh potatoes. Analysis of retail sales in 4 metropolitan areas indicated that dehydrated mashed potatoes have penetrated the market for mashed potatoes to the extent that 1 pound of mashed is now prepared from dehydrated flakes or granules for every 6 pounds from fresh potatoes.

Dehydrated mashed and frozen french fried potatoes also have made considerable penetration into the institutional market. A survey in the Philadelphia metropolitan area revealed that the number of Philadelphia restaurants using frozen french fries doubled from 1958 to 1960, and the number using dehydrated mashed potatoes tripled. By April 1960, 39 percent of the restaurants were using frozen french fries, and nearly a third were using dehydrated mashed potatoes.

1/ U. S. Department of Agriculture, Crop Reporting Board. Irish Potatoes, Utilization of 1960 Crop with Comparisons. September 14, 1961.

Data on methods of preparation in restaurants revealed that 29 percent of all potatoes were served mashed; almost a third of these were prepared from dehydrated. French fries accounted for 36 percent of all potatoes served by restaurants, and over half of these were prepared from frozen french fries.

Schools and hospitals served 50 percent of all their potatoes as mashed and 39 percent of these were prepared from dehydrated. Only 7 percent of the potatoes were french fried, but two-thirds of these were prepared from frozen french fries.

Dehydrated mashed and frozen french fried potatoes constitute a sizable share of total potato use by institutions, but a potentially large market remains. About 48 percent of the restaurants had never tried frozen french fries, and 42 percent had never tried dehydrated mashed potatoes. Many of the nonusers would start using them if given an opportunity to use them on a trial basis. About three-fourths of the restaurants which had tried frozen french fries are using them on a regular basis to prepare all or nearly all of their potatoes served as french fries. Similarly, a little more than half of the restaurants that tried dehydrated mashed potatoes are now using them on a regular basis to prepare half or more of their mashed potatoes.

BACKGROUND

The objectives of the study were to determine (1) the level of and trends in sales of dehydrated mashed potatoes and frozen french fries in retail food outlets; (2) trends in use, marketing practices, and problems in the use of dehydrated mashed potatoes and frozen french fries in selected segments of the institutional market; and (3) the net effect of increased use of potatoes in processed form on total consumption of potatoes and on returns to growers. Special emphasis was given to dehydrated and frozen potato products because these offer the greatest potential for expanding the use of potatoes. Within the last several years, marked increases have been observed in the utilization of potatoes by freezers and dehydrators. Nearly 13.4 million hundredweight of potatoes were used in making frozen french fries in 1960, double the quantity used in 1958. Processors of flakes, granules, and other forms of dehydrated potatoes used 10.1 million hundredweight from the 1960 crop or twice the quantity used from the 1958 crop.

Potato Consumption and Utilization Patterns

Potato producers have been faced with a shrinking demand for potatoes. Until markets for dehydrated and frozen potatoes were developed, the amount of potatoes consumed per person had been diminishing for several decades. By 1950, consumption had dropped to about half the 1910 level. For the past decade, consumption has held at about the 1950 level. Many observers attribute this leveling off to the advent of frozen and dehydrated potatoes.

With prospects of continued high consumer incomes and less emphasis on low-priced foods, the possibility of maintaining or increasing per capita potato consumption may become increasingly dependent upon processing. This conclusion is supported by an analysis of the Department's 1955 Household Food Consumption

study. These data reveal that beginning at family incomes of $3,000 to $4,000 purchases of raw potatoes per person tend to decrease as income increases. But just the opposite is true of processed potatoes.

Industry representatives predict a bright future for processed potatoes. The proportion of potatoes used for processed foods increased from 2 percent of the 1940 crop to 24 percent of the 1960 crop, and industry spokesmen estimate that by 1970 over 50 percent of the crop will be processed. 2/

Number of Potato Processing Plants

The number of potato processing plants has increased at a rapid rate--especially the number of plants producing potato flakes. The potato flake process was developed in 1956 under public patent, which permits freedon of entry to all processors. This accounts in part for the rapid growth in the number of new plants and companies now processing and selling this product. In May 1961, there were 16 processors of dehydrated mashed potatoes, 12 of which were processing flakes. 3/ In addition, there were 5 flake plants which were either under construction or not yet in production and 2 were not currently operating. Flakes of good quality are made from most major varieties having a wide range of solids contents. This appears to be one of the reasons for the rapid increase in the number of flake processors in relation to granule processors, since granules are made only from potatoes of high-solids content. Another reason is that flake plants are being located in major potato-growing areas other than Idaho, where the processing of dehydrated potatoes originated and where 4 of the 5 granule producers are located.

By May 1961, there also were 38 plants producing frozen french fries and 12 additional plants were either in the planning stage, under construction, or not yet in production. Most of the plants were in northern states, where late-crop potatoes are produced and stored (table 1).

IMPACT OF NEW POTATO PRODUCTS ON CONSUMERS, PROCESSORS AND GROWERS 4/

The introduction of new potato products on a fairly large scale since 1956 has resulted in significantly larger proportions of the potato crop going into processing each succeeding year. During the 1956-60 period, per person use of

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2/ Feustel, I. C. Review of Potato Processing. Speech presented at the 17th annual convention of the Potato Growers Association of California and Arizona, Bakersfield, Calif. March 14, 1961.

3/ Processors of potato granules also have expanded facilities greatly in the last several years. Before and concurrent with the flake development, the Department has maintained a research program in close cooperation with potato granule producers which has resulted in improvements in process efficiency and product quality.

4/ Some of the data used in estimating the impact of new potato products were supplied by the Economic and Statistical Analysis Division, Economic Research Service.

Table 1.--Plants processing dehydrated mashed and frozen french fried potatoes, by States, May 1, 1961 1/

State	In production			Not in production 2/		
	Frozen french fries	Dehydrated		Frozen french fries	Dehydrated	
		Flakes	Granules		Flakes	Granules
Idaho	8	2	3/ 4	3	5	-
Washington	5	-	-	1	-	-
Maine	5	1	-	5	1	-
New York	4	2	-	-	-	-
Pennsylvania	3	-	-	-	-	-
California	2	-	1	-	1	-
Illinois	2	-	-	-	-	-
Oregon	1	1	-	-	-	-
Minnesota	1	1	-	-	-	-
Arkansas	1	-	-	-	-	-
Connecticut	1	-	-	-	-	-
Kansas	1	-	-	-	-	-
Maryland	1	-	-	-	-	-
Massachusetts	1	-	-	-	-	-
New Jersey	1	-	-	-	-	-
Rhode Island	1	-	-	-	-	-
North Dakota	-	4	-	1	-	-
Michigan	-	1	-	-	-	-
Colorado	-	-	-	1	-	-
Nebraska	-	-	-	1	-	-
Total	38	12	5	12	7	0

1/ The Vegetable Branch, Fruit and Vegetable Division, Agricultural Marketing Service, furnished the data for the preparation of this table.

2/ Includes plants under construction, in planning stage, and currently not in production.

3/ One plant is only packaging.

dehydrated and frozen potatoes more than doubled, offsetting the long-term decline in fresh potato use which continued during the 5-year period, and total use of potatoes increased (table 2).

While there is general agreement that the halting of the decline in potato consumption in the last several years is a good thing for the potato industry, there is a lack of general agreement as to what the changes in the pattern of potato consumption may mean to potato producers, processors, and consumers.

First let us examine some of the implications of increased processing to consumers. Available sales figures and consumption statistics leave no doubt that processed potato products fit well into today's living patterns of suburbia, working wives, and the trend toward quick easy-to-prepare foods. Whether or

Table 2.--Use of potato products per person, crops of 1956-60 1/

Products	1956	1957	1958	1959	1960
	Pounds	Pounds	Pounds	Pounds	Pounds
Fresh	93.0	92.1	90.2	88.0	86.6
Chips	8.7	10.2	9.9	11.5	11.9
Frozen	2.8	2.8	4.8	5.6	8.4
Dehydrated	1.9	2.2	3.4	4.3	5.6
Canned	1.4	1.5	1.6	1.4	1.6
Total	107.8	108.8	109.9	110.8	114.1

1/ Based on utilization reported by Crop Reporting Board divided by January 1 civilian population of the United States. Excludes flour and starch.

not the consumer is paying too high a price for the added conveniences built into potatoes by processing is not as easily resolved. From the data gathered in this study and in previous and current research, costs of dehydrated and frozen potato products appear to be favorable in relation to fresh if one places some monetary value on time saved in preparation and on reduction of loss through spoilage. The ingredient cost per serving of processed and fresh potatoes is discussed on pages 15 and 19-21.

The case for processed potatoes as positive contributors to the welfare of the processing segment of the potato industry also is obvious. The expansion, both in existing and new plants, for frozen potato products, granules, and other forms of dehydrated potatoes has been pronounced. In 1961, there were 12 flake plants operating, whereas there were none prior to the market test in 1956.

Innovations in the potato industry have had some effect on growth of the general economy. Investment in equipment for the flake plants amounted to $2.5 million by 1959. In addition, $10 million is being spent annually for labor, management, advertising, packaging materials, and other goods and services Even greater expenditures have occurred for plant, equipment, and related items in other sectors of the potato processing industry. Generally speaking, the impact of new products on the economy tends to be beneficial in the long run. Spending for new and more efficient equipment and new plant layouts tends to promote economic growth.

No precise statistical measurement has been made of the effect of dehydrated and frozen products on potato consumption in all forms or of income-generating effects of new potato products. The recency of the innovations and the unavailability of prices paid for potatoes by processors make it difficult to get estimates of the effect of new potato products on income.

However, by making what appear to be logical assumptions, it is possible to get some indication of the impact of these new products on per capita consumption of potatoes for food, and on gross returns to growers. The central assumption is that had there been no increase in use of dehydrated and frozen

potato products since 1956, per capita consumption of potatoes in all forms for the years 1957 through 1960 would have been the same as the 1956 level. This seems a reasonable assumption based on consumption behavior in the years immediately preceding 1956. Accordingly, total per capita consumption for each of the years 1957, 1958, 1959, and 1960 is estimated at 107.8 pounds, the same as in 1956.

Table 3 shows estimated and actual per capita consumption since 1956. Given an equality in 1956 between the actual and estimated per capita consumption, differences between the two figures were computed for the years 1957 through 1960. Estimated per capita consumption fell short of actual per capita consumption by 1.0, 2.1, 3.0, and 6.3 pounds per person.

A rough approximation of the effect of potato product innovation on gross returns to growers can be made by converting the higher actual per capita consumption figures to a higher total consumption, then assigning price and computing a value for the amount by which total actual consumption exceeded estimated consumption.

Table 3.--Actual potato consumption, and estimates based on 1956 per capita consumption, crop years 1957-60 1/

Utilization of potatoes	1956	1957	1958	1959	1960
	Pounds	Pounds	Pounds	Pounds	Pounds
Per person:					
Actual	107.8	108.8	109.9	110.8	114.1
Estimated 2/	107.8	107.8	107.8	107.8	107.8
Increase	---	1.0	2.1	3.0	6.3
	1,000 cwt.	1,000 cwt.	1,000 cwt.	1,000 cwt.	1,000 cwt.
Total:					
Actual	180,107	185,149	190,254	195,149	204,100
Estimated	180,107	183,450	186,686	189,921	192,941
Increase	---	1,699	3,568	5,228	11,159

1/ Based on utilization reported by the Crop Reporting Board--excluding starch and flour.
2/ Assuming that per capita consumption of fresh and chips combined had leveled off by 1956.

For example, processors who generally buy potatoes on a field-run basis often sell the more desirable qualities in the fresh market. Consequently, the potatoes which actually go into processing are valued at something less than the average price per unit received by growers. If potatoes used in processing in 1960 had an average value of $1.50 per hundredweight (roughly $0.50 less than

the national average price received by farmers, and $0.33 less than the average received by growers in Idaho), the additional potatoes used for food in 1960 (over 11 million hundredweight as a result of increases in frozen and dehydrated products) would have meant an increase in gross returns to growers of about $17 million. If an even lower processing value of $1.25 per hundredweight is assigned, an increase in gross returns of about $14 million still would have resulted. Similarly, increased processing in 1957, 1958, and 1959 also meant increased gross returns to growers, though the increases were smaller than in 1960.

TEST CITIES AND METHODOLOGY

Retail Market Study

Four large metropolitan areas, in different regions, were selected for the sales audit phase of the market penetration study. The markets were chosen to compare variations between regions in sales, availability of brands, price, and related factors bearing on the sales of dehydrated mashed potatoes. The markets selected were Philadelphia, Oakland, Milwaukee, and New Orleans. Sales of dehydrated mashed potatoes were audited in 3 supermarkets in each metropolitan area once a month for 6 months. The stores selected represented 3 of the largest chain organizations in these cities. Prices of fresh and processed potatoes were obtained.

Institutional Market Study

Philadelphia was the market selected for intensive study of institutional markets because it was one of the first large northeastern metropolitan areas to use relatively large amounts of processed potatoes.

In the standard Philadelphia metropolitan area 5/, information was obtained from all known firms supplying dehydrated and frozen french fries to institutional users concerning the size and characteristics of the institutional market for those products. These 30 institutional suppliers handled almost all of the sales of dehydrated mashed potatoes and frozen french fries in the area. A total sample of 314 institutions was drawn to represent restaurants, schools, and hospitals within the standard Philadelphia metropolitan area. This sample consisted of a random sample of 166 restaurants and 34 schools and hospitals, and all of the 114 qualified members of the Philadelphia Restaurant Association. The random sample was selected from all telephone listings in the Philadelphia metropolitan area. Eating establishments of the snack and sandwich type, and those which derived their income mainly from sales of items other than food, such as bars, were not included in the sample.

RESULTS OF RETAIL MARKET STUDY

Retail Sales in Four Metropolitan Areas

Analyses of the audit of retail sales for a 6-month period (November 1959-May 1960) in supermarkets in 4 cities revealed that dehydrated mashed potatoes accounted for 4.5 percent of total potato sales and frozen french fried potatoes

5/ Includes Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania, and Burlington, Camden, and Gloucester counties in New Jersey.

for 5.4 percent, or a total of almost 10 percent (fig. 1). The degree of market penetration varied a great deal between metropolitan areas. The combined sales of the two products ranged from 16 percent of total potato sales in the Philadelphia supermarkets to less than 5 percent in New Orleans. Sales of dehydrated mashed potatoes were greater in Philadelphia than combined sales of both frozen french fries and dehydrated mashed in Oakland and New Orleans. The lower sales of processed potatoes in the western and southern markets appear to be due to strong competition from rice and vegetables other than potatoes. The relative importance of each product also varied among the 4 markets. Frozen french fries outsold dehydrated in Philadelphia and Milwaukee, but the reverse was true in New Orleans and Oakland.

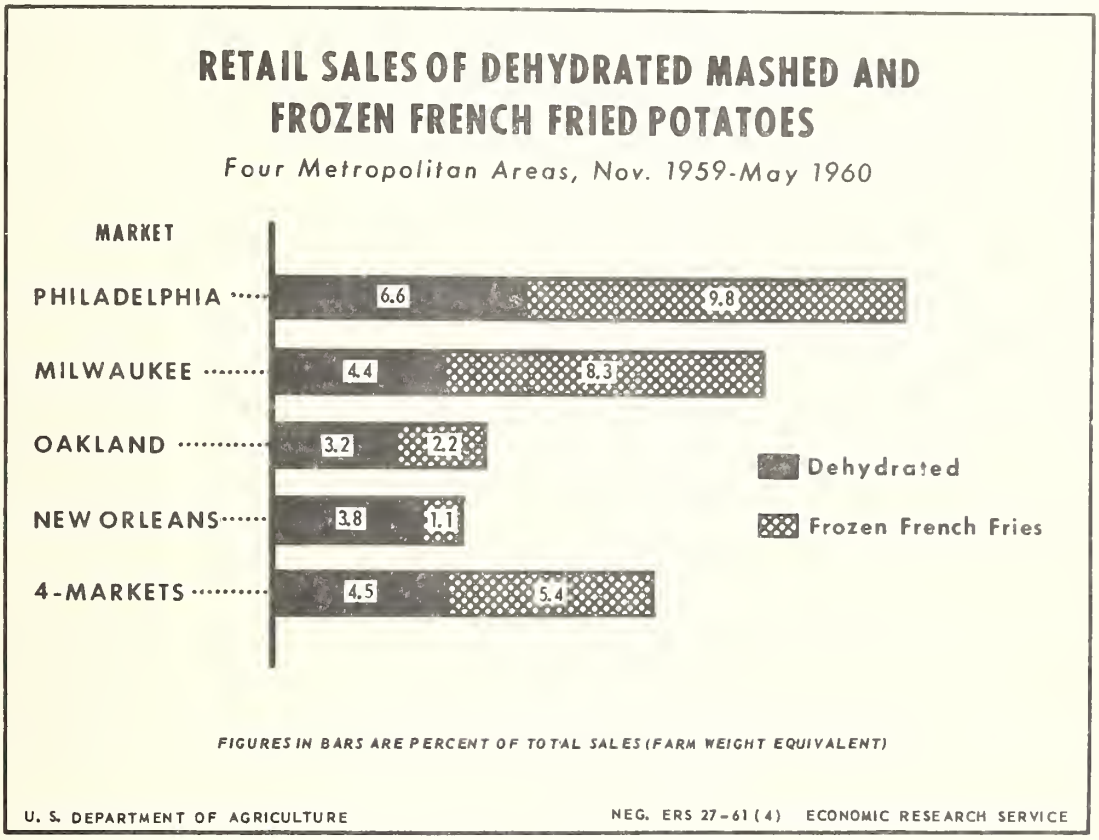

Figure 1

Granules accounted for the largest share of total dehydrated mashed potato sales; but the retail audit data indicate that the spread is narrowing between granules and flakes. In November 1959, 3.4 pounds of granules were being sold to every pound of flakes in the audited stores. In May 1960, when the audit ended, the ratio had narrowed to 1.7 to 1.0. This is attributed in part to the introduction of additional nationally advertised brands. The average for the 6-month period was 2 pounds of granules to 1 pound of flakes. This relationship of 2 to 1 also was observed in the institutional market.

Households Using Processed Potato Products

The consolidated consumer analysis of 1960 issued by the Milwaukee Journal shows the number of households using dehydrated mashed potatoes in 21 markets and the percentage of households using frozen french fries in 4 of the 21 markets (table 4).

Table 4.--Household use of instant and frozen french fried potatoes, 21 markets, 1960 1/

City	Number of households covered by survey	Percentage of households using	
		Instant potatoes	Frozen french fried potatoes
Chicago	7,410	26.5	--
Columbus	2,400	23.4	33.0
Denver	3,350	26.3	--
Duluth-Superior	1,600	19.9	--
Fresno	1,662	20.8	18.0
Honolulu	2,500	13.0	--
Indianapolis	4,200	21.5	--
Long Beach	2,944	28.4	--
Milwaukee	6,459	22.4	--
Modesto	900	23.3	17.2
Newark	3,000	27.4	--
Omaha	2,787	23.2	--
Phoenix	2,810	21.8	--
Portland, Ore	2,726	21.5	--
Providence	2,869	21.1	--
Sacramento	2,938	25.9	26.2
Salt Lake City	1,310	20.1	--
San Jose	2,343	21.0	--
Seattle	4,000	18.7	--
St. Paul	3,100	20.8	--
Wichita	2,119	21.8	--
All markets	63,427	22.3	23.6

1/ Milwaukee Journal. Consolidated Consumer Analysis of Buying Habits and Brand Use, 1960.

Twenty-two percent of all households in these markets purchased dehydrated mashed potatoes in 1960. The range varied from 13 percent in Honolulu to 28 percent in Long Beach. The number of households buying in 1960 represents an increase of 7 percentage points over the number reported buying in a 9-market survey in 1959 for the same markets. Thirteen brands of dehydrated mashed potatoes were purchased in the 21 markets. Only 3 of these were available in all

21 markets, while 7 were available for purchase in less than 4 of the markets. Two out of every three households reported they bought potato granules the last time they purchased dehydrated mashed potatoes.

In 4 markets, 24 percent of all households had purchased frozen french fries during 1960. The number of brands per market ranged from 11 to 21 and averaged 16.

Market Penetration and Potential

The retail market for frozen french fries and dehydrated mashed potatoes may be expanded considerably over the 1 to 2 percent per year anticipated as a result of population increases.

Four-fifths of the total food supply moves through retail channels, and the retail market offers the largest long-run potential for expanding the sales of dehydrated mashed and frozen french fried potatoes. An estimated three-fifths of dehydrated mashed potatoes and two-fifths of the frozen french fries are sold in the retail market.

To compare the market potential of dehydrated mashed potatoes and frozen french fries in the 4 metropolitan areas, it was assumed that consumption per person in each metropolitan area was equal to regional consumption figures as reported in the 1955 "Food Consumption of Households in the United States." 6/ Per person consumption of dehydrated mashed and frozen french fries in each urban area was calculated by multiplying the retail sales percentages of each product by the annual potato consumption per person in each region as estimated from the 1955 study. Annual consumption was estimated by multiplying the per person weekly consumption by 52.

For example, estimated potato consumption in the North Central Region was 118 pounds per person. The retail store audit in Milwaukee revealed that dehydrated mashed potatoes accounted for 4.4 percent of total potato sales. Per person consumption of dehydrated mashed potatoes in Milwaukee was then estimated by multiplying 118 by 0.044, which equals 5.2 pounds. The same procedure was used for estimating consumption in other markets and for frozen french fries.

Estimated per person consumption of all potatoes in the 4 markets combined averaged approximately 95.5 pounds, of which 76.2 pounds were purchased in the fresh form (table 5). Of the 4 markets, Milwaukee appears to offer the best potential for dehydrated and frozen french fried potatoes. Per person consumption of fresh in the Milwaukee market was larger than total consumption of all forms of potatoes in the Oakland and New Orleans markets.

Another method of examining market expansion possibilities for dehydrated mashed and frozen french fries is to estimate on the basis of previous studies the amounts of fresh potatoes used in households as mashed or french fried

6/ U. S. Department of Agriculture. Food Consumption of Households in the United States. Household Food Consumption Survey 1955, Rpt. No. 1, 196 pp., Dec. 1956.

Table 5.--Annual per person consumption of potatoes, based on retail sales audit, four metropolitan areas, November 1959-May 1960 (farm-weight equivalent)

Form of potatoes	Milwaukee	Philadelphia	Oakland	New Orleans	4 markets
	Pounds	Pounds	Pounds	Pounds	Pounds
Fresh	88.1	78.6	72.0	65.9	76.2
Frozen french fries	9.8	10.0	1.9	.8	5.6
Dehydrated mashed	5.2	6.7	2.8	2.9	4.4
Other processed	14.9	6.7	9.3	6.4	9.3
Total	118.0	102.0	86.0	76.0	95.5

potatoes. 7/ These estimates indicate that the preparation of mashed potatoes from fresh potatoes is 3 or 4 times greater than the preparation of french fries from fresh potatoes. Estimates of mashed potato consumption from fresh potatoes on a per person farm-weight equivalent range from 30 pounds in Milwaukee to 22.4 in New Orleans. The average of the 4 markets would be 26 pounds or almost 6 times the present use of dehydrated mashed potatoes (fig. 2).

A smaller market exists for frozen french fries unless a change occurs in the previously established household utilization patterns for preparing fresh potatoes. The 4-market average reveals that consumption of french fries from fresh potatoes is about 6.8 pounds per person, or only about 1.3 times the amount of frozen french fries presently used. The range is from 7.9 pounds in Milwaukee to 5.9 in New Orleans.

Other Factors Affecting Sales

New Brands

Total sales during the audit period fluctuated a great deal from month to month as a result of introductory offers of new brands. Sales were almost tripled in several stores one month as a result of a special introductory price on a new brand coupled with a special display. In other instances special promotion had little, if any, affect on sales.

The introduction of several new brands of dehydrated mashed potatoes during the retail audit phase of the study was undoubtedly responsibile for the high level of promotional activities for dehydrated mashed potatoes in these areas and nationally as well. For example, during 1959, over $7 million was invested in advertising for dehydrated mashed potatoes (table 6). In comparison, less than $1 million was spent in promoting fresh potatoes.

7/ Market potential computations were based on estimates that 34 percent of fresh potatoes in household use were mashed and 9 percent were french fried.

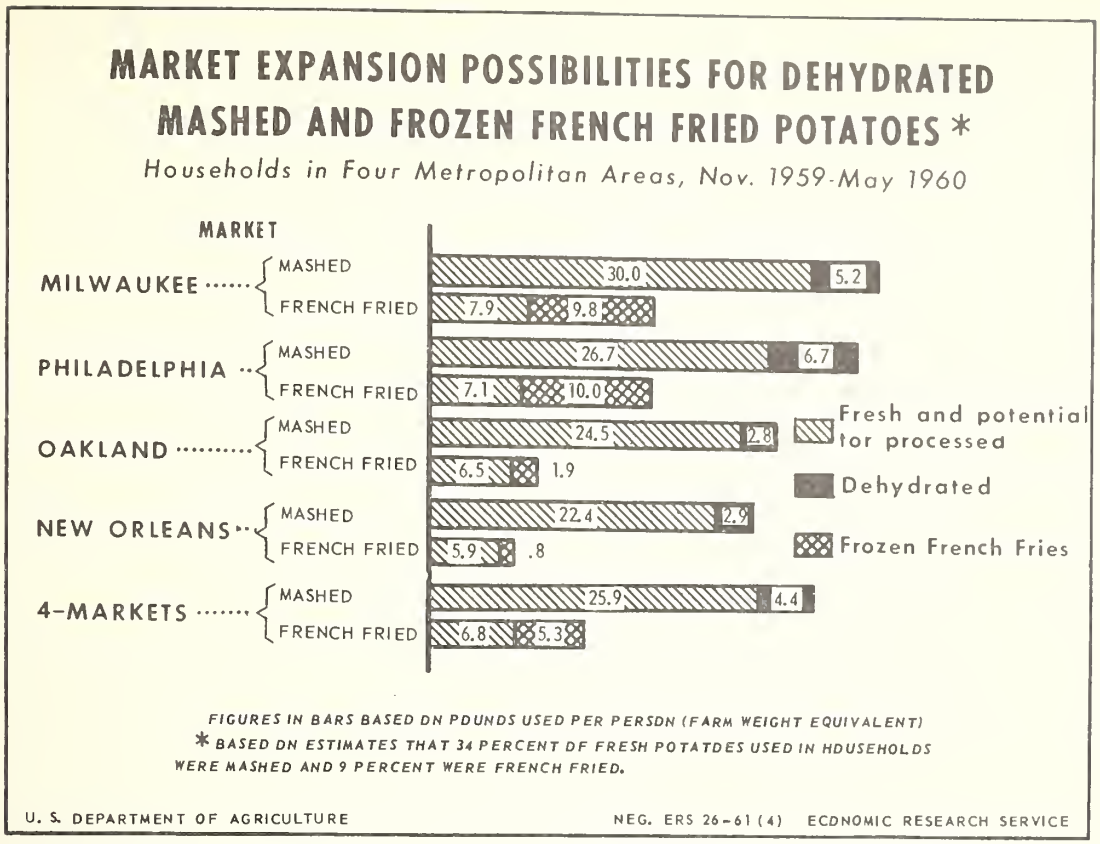

Figure 2

Table 6.--Advertising expenditures by manufacturers of dehydrated mashed potatoes, by media, United States, 1959 1/

Form	General magazine	News-papers	Newspaper sections	Network TV	Spot TV	Total
	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars	1,000 dollars
Flakes	112	1,230	521	23	1,256	3,142
Granules	152	538	147	1,307	2,010	4,154
Total	264	1,768	668	1,330	3,266	7,296

1/ Food Field Reporter, June 20, 1960.

Dehydrated mashed potatoes.- A wide choice of brands of dehydrated mashed potatoes was available. Both flake and granule brands were found in all markets. A total of 11 brands were observed in the 4 markets--7 brands of flakes and 4 of granules. Granule brands were more widely distributed than flakes. The granule brands were found in all 4 metropolitan areas, but only 2 of the flake brands were available in all 4 areas.

The average number of flake brands available per store almost doubled during the 6-month period November 1959 through April 1960 (table 7). At the beginning of the period there was an average of 1 brand of flakes available per store. The introduction of new brands had increased this to 2 per store at the end of 6 months. The number of granule brands remained 3 per store.

Table 7.--Average number of brands of dehydrated mashed potato flakes and granules available per store, 4 metropolitan areas, November 1959 and April 1960

Market area	Flakes		Granules	
	November	April	November	April
	Brands	Brands	Brands	Brands
Philadelphia	2	3	2	3
Milwaukee	1	3	3	3
New Orleans	1	2	3	3
Oakland	1	2	2	3
Average 4 markets	1	2	3	3

Frozen french fried potatoes.- Regional rather than national brands of frozen french fries predominated. In the 12 sample stores, 24 different brands were observed but only 1 was available in all 4 markets.

Frozen french fries were found to be uniformly available in all 4 metropolitan areas. From 2 to 3 brands were stocked in almost all the stores. Several of the stores handled both a 9- and 16-ounce package of the same brand.

Price

The price of dehydrated potatoes averaged almost twice as much in the retail market as in the institutional market, and frozen french fries averaged a little more than 1-1/2 times as much. This resulted primarily from higher packaging and merchandising costs involved in retail selling.

The average retail price of dehydrated mashed potatoes in 4 metropolitan areas from May 1959 to April 1960 was 73.8 cents per pound, which is equivalent to 10.5 cents per pound of fresh potatoes. Frozen french fries averaged 32.1 cents per pound or 18 cents for the 9-ounce retail package (table 8).

Retail prices of dehydrated mashed, frozen french fried, and fresh potatoes from May 1959 to April 1960 are shown in figure 3. Prices of processed potatoes fluctuated less than prices of fresh potatoes. The standard deviation of the average price per pound was several times larger for fresh potatoes than for dehydrated mashed potatoes and frozen french fries on a farm-weight equivalent basis.

Table 8.--Average retail price of dehydrated mashed and frozen french fried potatoes, 4 metropolitan areas, May 1959-April 1960

Metropolitan area	Dehydrated mashed		Frozen french fries	
	Per pound	Per 6-1/2-ounce package	Per pound	Per 9-ounce package
	Cents	Cents	Cents	Cents
Oakland	79.7	32.4	35.4	19.9
Philadelphia	74.9	30.4	31.7	17.8
New Orleans	71.0	28.9	31.7	17.8
Milwaukee	69.6	28.3	29.6	16.6
Average	73.8	30.0	32.1	18.0

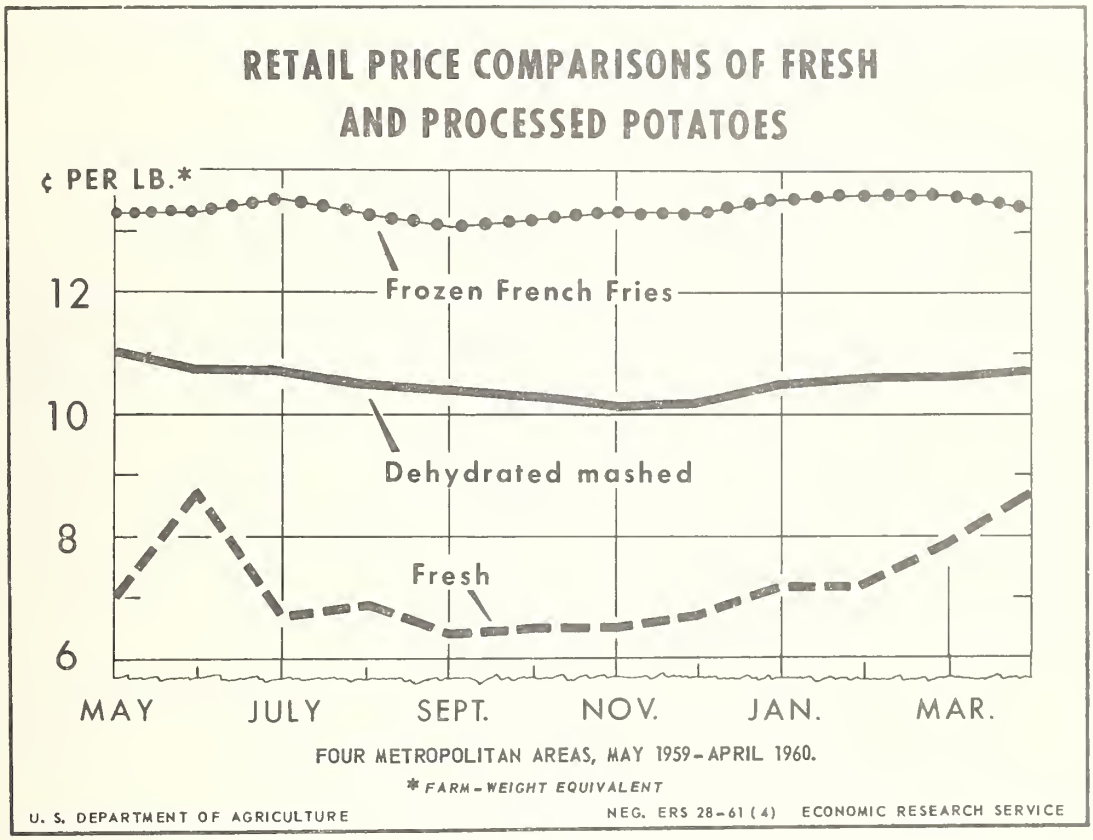

Figure 3

The low prices for frozen french fries were observed during September and October. For dehydrated mashed potatoes, prices were lowest during November and December. Prices of fresh potatoes were lowest from September to December. Fresh potatoes were exceptionally high in June 1959 because of an unusual supply situation for the spring crop.

The ingredient cost of a 3.5-ounce serving of mashed potatoes was 2.2 cents when prepared from fresh potatoes and 3.4 cents when prepared from dehydrated

mashed potatoes. The ingredient cost of a 2-ounce serving of french fries was 5.3 cents for fresh potatoes, and 5.6 cents for frozen french fries. 8/ But, of course, the processed forms have services added to the product; preparation and cleanup time is cut and waste is reduced. Household consumers apparently are willing to pay a price premium for these convenience features.

RESULTS OF INSTITUTIONAL MARKET STUDY

Forms of Potatoes Used

As expected, fresh potatoes accounted for the largest share of the potatoes used by the institutions studied in Philadelphia. 9/ The other important forms used were frozen french fries, dehydrated mashed, and potato chips.

Frozen french fries and dehydrated mashed potatoes ranked next to fresh potatoes in quantity used. Restaurants used more frozen french fries than dehydrated mashed potatoes (fresh basis); but schools and hospitals used more dehydrated mashed potatoes than frozen french fries, since french fries seldom appear on their menus (table 9).

Table 9.--Potatoes used per week by institutions and percentage used in various forms, Philadelphia metropolitan area, May 1959-April 1960 1/

Forms	166 restaurants	34 schools and hospitals	200 institutions
	Pounds	Pounds	Pounds
Total (farm-weight equivalent)	118,629	40,443	159,072
	Percent	Percent	Percent
Fresh	61.2	61.5	61.3
Frozen french fries	18.9	4.8	11.3
Dehydrated	8.4	19.6	15.3
Chips	7.1	7.9	7.3
Peeled whole	2.5	5.4	3.2
Peeled sliced	1.5	.4	1.2
Other	.4	.4	.4
Total	100.0	100.0	100.0

1/ Conversion factors used were: 2.4 pounds of fresh potatoes equivalent to a pound of frozen french fries; 7 pounds of fresh potatoes equivalent to a pound of dehydrated mashed potatoes.

8/ The assumptions and method of calculating the cost per serving are shown in the appendix, page 27. These calculations do not include time of preparation differences, fuel costs, and other aspects of convenience or inconvenience as it affects the preparation of the two forms being compared.

9/ A special group of restaurants were studied in addition to the sample of restaurants reported on here. The results of the special study are in the appendix, page 25.

Use Patterns of Processed Potato Products

In Philadelphia, 39 percent of the sample restaurants were using frozen french fries and 31 percent were using dehydrated mashed potatoes; 19 percent were using both (table 10). 10/

Table 10.--Experience of institutions with dehydrated mashed potatoes and frozen french fries, Philadelphia metropolitan area, April 1960

Type of experience	Dehydrated mashed potatoes			Frozen french fries		
	166 restaurants	34 schools and hospitals	200 institutions	166 restaurants	34 schools and hospitals	200 institutions
	Percent	Percent	Percent	Percent	Percent	Percent
Now use	31	68	37	39	32	38
Never tried	42	9	37	48	62	50
Tried - but do not use	27	23	26	13	6	12
Total	100	100	100	100	100	100

Around half of the large and medium restaurants, but only a fourth of the small restaurants used frozen french fried potatoes. About a third of the large and medium restaurants used dehydrated mashed potatoes, but only a fifth of the small restaurants used this product (table 11).

Table 11.--Experience of restaurants with dehydrated mashed potatoes and frozen french fries, Philadelphia metropolitan area, April 1960 1/

Product and experience	Small restaurants		Medium restaurants		Large restaurants	
	Number	Percent	Number	Percent	Number	Percent
Frozen french fries:						
Now use	15	25	39	46	12	54
Do not use	45	75	45	54	10	46
Total	60	100	84	100	22	100
Dehydrated mashed:						
Now use	13	22	31	37	7	32
Do not use	47	78	53	63	15	68
Total	60	100	84	100	22	100

1/ Small restaurants, less than 100 lunches and dinners served per day; medium, 100 to 399; large, 400 and over.

10/ See page 25 of the appendix for a more technical discussion of the number of users.

Two-thirds of the schools and hospitals were using dehydrated mashed potatoes and one-third were using frozen french fries; 14 percent used both. According to officials responsible for menu preparation, french fried potatoes were not served oftener because of their cost and for nutritional reasons.

The greatest potential market for frozen french fries and dehydrated mashed potatoes is among the restaurants which have never tried them. More restaurants had never tried these products than had tried but discontinued using them. Four-fifths of the sample restaurants which were not using frozen french fries and three-fifths of those not using dehydrated mashed potatoes had never tried them.

Eleven percent of the restaurants using frozen french fries were part-time users. On the other hand, almost half of the restaurants using dehydrated mashed potatoes were part-time users. One-fourth of all users prepared 5 percent or less of their mashed potatoes from the dehydrated form. However, 61 percent of the 54 part-time users had increased the percentage of their mashed potatoes prepared from dehydrated during the 12 months preceding April 1960; 33 percent reported no change, and 6 percent reported a decrease.

Untapped Market

The quantity of dehydrated mashed and frozen french fried potatoes used was analyzed to determine the degree of market penetration of these two products in the Philadelphia market. The findings reveal that considerable inroads have been made into the institutional market by these two products, and further growth seems likely.

The present use of potatoes provides a measure for determining the market potential for dehydrated mashed and frozen french fried potatoes. Average use of potatoes per restaurant in Philadelphia was 715 pounds per week (farm-weight equivalent). Of this amount, 254 pounds, or 36 percent, were served as french fries and 206 pounds, or 29 percent, as mashed potatoes (fig. 4). Frozen french fries account for about 53 percent of total french fries served, while dehydrated mashed potatoes account for about 29 percent of total mashed potatoes served.

Greater penetration has been made in the market for frozen french fries and dehydrated mashed in the schools and hospitals than in restaurants. The average use of all potatoes in schools and hospitals was 1,190 pounds per week (farm-weight equivalent). Half of this quantity was served as mashed potatoes, and 39 percent of the mashed potatoes were prepared from dehydrated potatoes. Only 7 percent of all potatoes were served as french fries, but 67 percent of these were prepared from frozen french fries.

Other Factors Affecting Market Penetration and Potential

A number of other factors affecting the market expansion possibilities for dehydrated mashed and frozen french fries in institutional use were studied. The factors studied include (1) length of time used, (2) cost of preparation of mashed potatoes, (3) opportunity to use on a trial basis, (4) price, (5) brands

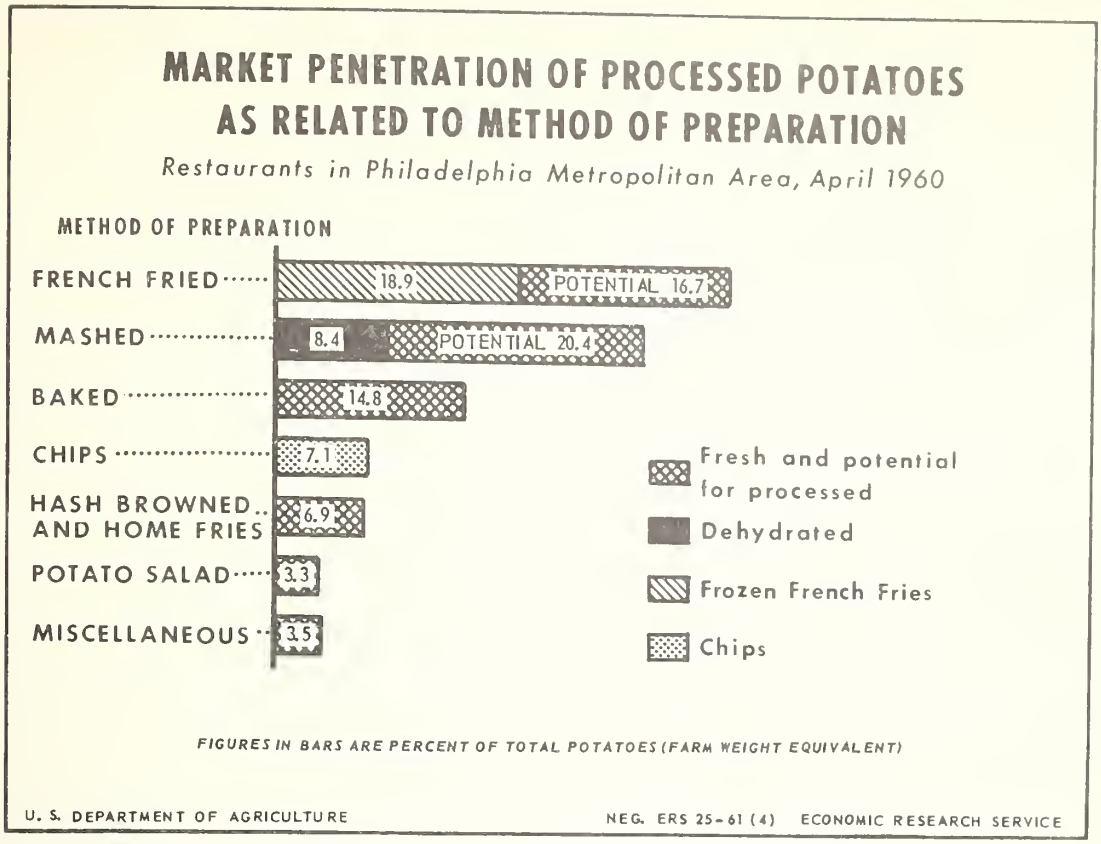

Figure 4

available, (6) quality of products, (7) frequency potatoes appear in menu, and (8) suggestions for product improvements. The findings indicated that both frozen french fries and dehydrated mashed potatoes have been well accepted by a large percentage of the institutions.

Length of Time Used

The number of restaurants using dehydrated mashed potatoes more than tripled from 1958 to 1960 (table 12). Half of the restaurants which were using dehydrated mashed potatoes in April 1960 had started to use them during the preceding 12 months. Only 15 percent had used them more than 3 years.

The number of hospitals and schools using dehydrated mashed potatoes doubled since 1958. On the average, schools and hospitals had used dehydrated mashed potatoes for 26 months, restaurants for 17 months.

The growth in the number of institutions using frozen french fries has not been as rapid as for those using dehydrated. The number of restaurants using them in April 1960 was double the number in 1958. The average length of time frozen french fries had been used was 33 months.

Table 12.--Percentage of institutions that had used processed potatoes for specified lengths of time, Philadelphia metropolitan area, April 1960

Period of use	Dehydrated mashed			Frozen french fries		
	Restaurants	Schools and hospitals	Total	Restaurants	Schools and hospitals	Total
	Percent	Percent	Percent	Percent	Percent	Percent
1 - 6 months	24.3	10.4	21.2	14.6	7.7	14.0
7 - 12 months	26.2	17.2	24.2	14.6	15.4	14.7
13 - 24 months	26.2	20.8	25.0	20.8	7.7	19.4
25 - 36 months	8.7	24.1	12.1	13.8	38.4	16.3
37 - 48 months	7.8	6.9	7.6	11.2	15.4	11.6
49 - 60 months	3.9	10.3	5.3	15.5	7.7	14.7
61 months and over	2.9	10.3	4.6	9.5	7.7	9.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Cost of Preparing Mashed Potatoes

The potential savings realized by substituting dehydrated mashed for fresh potatoes varied a great deal by origin of the fresh potatoes. The cost of preparing mashed potatoes from dehydrated was slightly less than the cost of preparing them from northeastern fresh potatoes, but considerable savings were possible when dehydrated potatoes were substituted for fresh potatoes from other areas (table 13).

The average restaurant could save money by using dehydrated mashed potatoes at 40 cents per pound, when fresh potatoes are above $2.83 per hundredweight (table 14). The major saving was in labor. The portion of labor savings that could be obtained by restaurants varied with the ability of restaurant managers to make profitable use of the labor time saved.

Labor costs.- The use of dehydrated mashed potatoes reduces time of preparation. The savings in work time resulting from eliminating the peeling and eyeing operations was three-fourths of a man-hour per day in the average restaurant. This savings amounted to $5.25 a week at a wage rate of $1.00 an hour.

Waste costs.- Two thirds of the institutions using dehydrated said that they were able to reduce waste in their operation by using dehydrated potatoes. The average reduction in the amount of mashed potatoes prepared but not served amounted to 6 percent of the mashed potatoes prepared.

Users of dehydrated mashed potatoes attributed the reduction in the quantity of wasted mashed potatoes to the long steamtable life and ease of preparing dehydrated mashed potatoes. The estimated satisfactory steamtable life of dehydrated mashed potatoes averages 3-1/2 hours compared to 2-2/3 hours for mashed potatoes prepared from fresh.

Table 13.--Comparative costs in preparing mashed potatoes from fresh and dehydrated, by area of origin of fresh potatoes, Philadelphia metropolitan area, April 1960

Cost item	Fresh potatoes		Dehydrated potatoes
	Northeast 1/	Other areas	
	Dollars	Dollars	Dollars
Raw material costs 2/	5.63	11.54	11.08
Labor costs, peeling and eyeing 3/	5.25	5.25	---
Waste 4/	.35	.71	---
Total costs 5/	11.23	17.50	11.08

1/ Maine, Pennsylvania, Delaware, New York, New Jersey, Connecticut, and Maryland.

2/ Based on an average amount of 194 pounds of mashed potatoes served weekly from fresh potatoes as reported by Philadelphia restaurants. The average weighted wholesale price of fresh potatoes for the Philadelphia market for 1960 was $2.90 per hundredweight for northeastern potatoes and $5.95 per hundredweight for potatoes from other areas. It was calculated that 27.71 pounds of dehydrated potatoes were needed to make the equivalent of the 194 pounds of mashed potatoes. The wholesale price for dehydrated mashed potatoes during the study was 40 cents per pound.

3/ Based on wage rate of $1.00 per hour for weekly average of 5-1/4 hours required for peeling and eyeing.

4/ Represents the 6 percent additional amount of mashed potatoes prepared but not served when fresh potatoes are used instead of dehydrated.

5/ Excludes cost of fuel, cleanup time, depreciation for potato peeling equipment, etc., and other ingredients.

Table 14.--Effect of price changes of fresh potatoes on comparative costs of preparing mashed potatoes for restaurant use from dehydrated and fresh, Philadelphia metropolitan area, April 1960 1/

Item	If the wholesale price per hundredweight of fresh potatoes were:				
	$1.83	$2.83	$3.83	$4.83	$5.83
Fresh potatoes: Raw material, labor, and waste	9.02	11.08	13.14	15.20	17.26
Savings by using dehydrated 2/	-2.06	0	2.06	4.12	6.18

1/ Comparative savings calculated here were based on the same cost factors used in table 13. The wholesale price of dehydrated mashed potatoes was 40 cents per pound dehydrated weight.

2/ Assumes constant raw material cost of $11.08 to prepare 194 pounds of mashed potatoes, the average quantity served weekly in Philadelphia restaurants.

Storage.- Practically all institutions were able to save storage space when using dehydrated potatoes. The majority estimated the savings to be less than 10 square feet because frequent purchases are made of bulky fresh vegetables like fresh potatoes to reduce the storage space problem.

Opportunity to Use on Trial Basis

Many institutions use new products on a trial basis before using them regularly. Almost 70 percent of the users of dehydrated potatoes served them on a trial basis before deciding to use them regularly. The length of these trials ranged from 1 to 30 days (table 15), but most of the users (72 percent) tried dehydrated for 7 days or less before deciding to use them on a regular basis. Three-fifths of those who tried them indicated that they found no difference between dehydrated and fresh mashed potatoes. The remaining group was about equally divided between those preferring either the taste of fresh or uniformity of dehydrated.

Table 15.--Institutions using potato products on a trial basis, by length of trial period, Philadelphia metropolitan area, April 1960

Length of trial period	Institutions trying frozen french fries		Institutions trying dehydrated mashed potatoes	
	Number	Percent	Number	Percent
1 day	16	26.4	33	37.0
2 days	1	1.6	5	5.5
3 days	6	9.8	5	5.5
4 days	3	4.9	2	2.2
7 days	18	29.5	20	22.2
10 days	-	-	2	2.2
14 days	7	11.5	8	8.8
15 days	1	1.6	-	-
21 days	1	1.6	4	4.4
24 days	1	1.6	-	-
30 days	5	8.2	11	12.2
90 days	2	3.3	-	-
Total	1/ 61	100.0	2/ 90	100.0

1/ 71 of the 134 users said they used them on a trial basis, but only 61 gave the length of time.

2/ 93 of the 133 users had used dehydrated mashed potatoes on a trial basis, but 3 did not remember how long.

The nature of the trial used for frozen french fries was similar to that used for other new products. A little over half of the users of frozen french fries reported that they initially used them on a trial basis. In the trial,

68 percent of the institutional users served the product to customers, 28 percent served it only to employees, and the remaining 4 percent tasted it themselves. The length of trial ranged from 1 to 90 days. Over 72 percent tried frozen french fries for 7 days or less. All of the institutional users indicated that their trial revealed a preference for french fries prepared from frozen french fries. Quality and labor savings ranked high among the reasons for choosing frozen french fries.

Price

Price was mentioned more often as a reason for not using frozen french fries than for not using dehydrated mashed potatoes. Twenty percent of the nonusers of frozen french fries felt that the price was too high, whereas dehydrated mashed potatoes were considered too expensive by only 5 percent of the nonusers.

The average price paid for dehydrated mashed potatoes was about 40 cents per pound in the Philadelphia institutional market. A wide range in prices was observed. Most of the variability was caused by differences in composition and yield of the many brands available.

The average price paid was slightly higher for flakes than for granules, on a dehydrated weight basis. However, flake users reported that they could obtain more servings from a pound of flakes because of their more porous structure than from a pound of granules, so that prices were about equal.

The average price paid per pound for frozen french fries was 19.7 cents. Prices ranged from 17 to 29 cents per pound, but 80 percent of the respondents reported paying from 18 to 20 cents.

All the institutions surveyed reported that frozen french fries were packaged in six 5-pound bags to the case. The average yield per pound was 4 servings, with four-fifths estimating they obtained 3 to 5 servings per pound.

Availability

A large number of brands of dehydrated mashed and frozen french fried potatoes were available on the Philadelphia institutional market. A survey of suppliers revealed there were 21 brands of dehydrated mashed potatoes on the market and 19 brands of frozen french fries. Granules accounted for 13 brands and flakes for 8 of the brands of dehydrated mashed potatoes.

There were 15 firms supplying frozen french fries and 15 firms supplying dehydrated mashed potatoes to institutional users. Suppliers handled an average of 3 to 4 brands of dehydrated mashed potatoes and an average of 2 brands of frozen french fries.

Restaurant operators indicated that quality was a key factor in deciding which brand of dehydrated mashed or frozen french fries to use. The recommendations of frozen food suppliers also influenced the choice of brands. Price appeared to be of minor importance in choosing a brand.

Quality

Two-thirds of the institutional users of frozen french fries felt that there was a difference in the quality of french fries prepared from fresh potatoes and frozen french fries. Practically all users rated frozen french fries superior in texture, color, and taste. The reason most often mentioned for preferring frozen french fries was uniformity. The color was preferred primarily because of evenness in browning and a golden color. The crispness of frozen french fries was cited as the major reason for preferring their texture.

Frequency of Use

Of the meals eaten in restaurants, 3.5 percent of the breakfasts, 53 percent of the lunches, and 72 percent of the dinners included potatoes (table 16).

Table 16.--Percentage of meals including potatoes, Philadelphia metropolitan area, April 1960

Type of institution	Breakfast	Lunch	Dinner
	Percent	Percent	Percent
Restaurants	3.5	53.1	71.8
Schools	-	37.7	-
Hospitals	0	54.7	64.5

In addition to dehydrated mashed potatoes and frozen french fries, several new products have been developed to enable homemakers and institutional users to prepare potatoes in numerous ways from dehydrated potatoes. The new forms of dehydrated potato products include (1) scalloped, (2) au gratin, and (3) potato slices for hash browned potatoes. Most of these products are now sold in retail stores, and it is anticipated that they will soon be sold to institutions. The availability of these new products may encourage more frequent use of potatoes.

Suggestions for Improvement

Of the 133 users of dehydrated mashed potatoes only 37 gave suggestions for improving the product, which seems to indicate it is acceptable without further improvement. The suggestions were:

Make quality comparable to fresh	14
Pack in smaller container	9
Add butter and milk	6
Improve texture	5
Reduce price	2
Exact formula for small portions	1
Total	37

Most users of frozen french fries were satisfied with the product. Over half of the suggestions were unrelated to the quality of the potatoes. The most important of these suggestions concerned packing improvements such as stronger bags and smaller packages. The suggestions were:

Packing improvements	21	
Stronger bags		10
Smaller units		6
Boxes instead of bags		5
Other	27	
Prevent thawing and breakage in transit		9
Make more uniform in length		5
Always use oil for blanching		4
Lower price		4
Improve taste and texture		3
Eliminate absorption of oil		2
Total	48	

Frozen french fries were available in only one size and type of package. This was a pasteboard carton of six 5-pound brown bags. The prevention of thawing and breakage in transit and the need for uniformity were other frequently mentioned improvements.

APPENDIX

Technical Notes

Data obtained by sample surveys are subject to sampling error and may differ somewhat from the results of a complete census. However, statistical techniques are available for estimating the magnitude of this difference. For example, survey results indicate that 30.7 percent of a random sample of restaurants in Philadelphia were using dehydrated mashed potatoes. The chances are about 2 out of 3 that values obtained from a census would fall between 27.2 percent and 34.2 percent. Thirty-nine percent of the restaurants were using frozen french fries. Chances also are about 2 out of 3 that a complete census would show that between 35.5 and 42.9 percent of the restaurants in Philadelphia were using frozen french fries.

The formula used for determining confidence intervals was:

$$\sqrt{\frac{N - n}{N - 1}} \qquad \sqrt{\frac{p(100-p)}{n}}$$

When N is the number of qualified restaurants in Philadelphia, n is the number of restaurants in the random sample, p is the proportion of respondents possessing the given characteristic, and 100-p is the number of respondents not possessing the characteristic.

Analysis of Special Group

It was pointed out by brokers and other groups in the wholesale restaurant trade that members of the Philadelphia Restaurant Association were more likely to be users of new products than nonmembers. Because of the alleged importance of this group in introducing new products, it was decided to determine their use of dehydrated and frozen french fries. All of the members of the Association were contacted.

The special study found that a higher percentage of members than of the random sample were using processed potatoes. While 54 percent of the members used frozen french fries, only 39 percent of the random sample used them. Similarly, 54 percent of the members used dehydrated mashed potatoes, but only 31 percent of the random sample used them (table 17).

Fresh potatoes accounted for 50 percent of the total potatoes used by member restaurants and for 62 percent of the potatoes used by restaurants in the random sample. Member restaurants used considerably more dehydrated and frozen french fried potatoes than nonmember restaurants. Frozen french fries accounted for 19 percent and dehydrated potatoes for 8 percent of the potatoes used by the random sample of restaurants, compared to 26 percent for frozen french fries and 13 percent dehydrated potatoes used by the members of the Philadelphia Restaurant Association.

Table 17.--Percentage of institutions using the various forms of potatoes, Philadelphia metropolitan area, April 1960

Type of establishment	Sample size	Percent using						
		Fresh	Chips	Frozen french fries	Dehydrated mashed	Peeled sliced	Peeled whole	Other
Random sample:								
Restaurants	166	96.4	47.0	39.2	30.7	6.0	5.4	7.2
Schools and hospitals	34	100.0	58.8	32.4	67.6	5.9	11.8	14.7
Total	200	97.0	49.0	38.0	37.0	6.0	6.5	8.5
Philadelphia Restaurant Association:								
Restaurants	105	94.3	49.5	54.3	54.3	9.5	10.5	10.5
Schools and hospitals	9	88.9	77.8	44.4	66.7	-	-	44.4
Total	114	93.8	51.8	53.5	55.3	8.8	9.6	13.2

Calculation of Cost Per Serving 1/

	Cents
POTATOES, FRENCH FRIED (2.0 ounces per serving)	
Home prepared:	
Fresh potatoes (1 pound)	7.68
Hydrogenated fat (6.4 oz. @ 1.94¢ per oz.) 2/	12.42
Total cost	20.10
Average cost per serving (3.8 per pound)	5.29
Frozen:	
Frozen french fries (9-oz. package)	18.09
Average cost per serving (3.2 per package)	5.65
POTATOES, MASHED (3.5 ounces per serving)	
Home prepared:	
Fresh potatoes (1 pound)	7.68
Milk (2.1 oz. @ 0.74¢ per oz.)	1.55
Total cost	9.23
Average cost per serving (4.1 per pound)	2.25
Instant:	
Dehydrated mashed (7-oz. package)	32.27
Milk (8.2 oz. @ 0.74¢ per oz.)	6.07
Total cost	38.34
Average cost per serving (11.1 per package)	3.45

1/ The Food Quality Laboratory, Human Nutrition Research Division, Agricultural Research Service, furnished the yield data for these calculations as a part of a cooperative study of convenience foods.

The calculations of the cost per serving allow for waste in peeling, and absorption of water.

2/ 2 pounds of fat were used to prepare five 1-pound batches of french fries. Therefore, the cost of 6.4 ounces of fat was assigned to each pound of fresh potatoes. However, the actual absorption during each frying is such that the fried product usually contains about 10 percent fat, or 1.6 ounces of fat per 1 pound of french fries.

* U.S. GOVERNMENT PRINTING OFFICE : 1961 O—616919

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